By Dr Erhard Briedenhann

SOYA BEAN STORAGE

and optimum moisture levels

Quality is an important parameter for the commercialisation and processing of grain, and affects the value of the product and its derivatives.

During post-harvest stages soya beans are subjected to qualitative and quantitative losses due to external factors. These factors may be physical such as temperature and humidity, chemical such as oxygen supply and biological such as bacteria, fungi, insects and rodents.

Physical, chemical and biological alterations may occur in soya beans depending on conditions and storage time. The three major factors affecting the storability of soya beans are moisture content, temperature and storage time.

The objective of storage is to preserve the characteristics of the grains after harvest. It is vital that the quality is preserved.

Soya bean quality during storage

The main characteristics that determine soya bean quality are low and uniform moisture content, low percentage of foreign material, discolouration, susceptibility to breakage, damage by heat (internal cracks), insect and fungal damage, elevated values of density, oil and protein concentration, and seed viability.

Some factors that can affect these characteristics are environmental conditions during the grain formation of plants, season, harvesting system, storage techniques and transport.

The grain mass is an ecological system in which deterioration is the result of interaction between physical, chemical and biological variables. The rate of deterioration during storage depends on the rate of change of these variables, which are directly affected by temperature and water content, and also their inter-relationship with the grain and storage structure. Insects, rodents and fungi are the main biological factors responsible for qualitative and quantitative losses in stored grains.

Pre-harvest losses will be minimised if the crop is harvested before the bean seed moisture reaches 10%.

Foreign material

Foreign material also affects the ability to store soya beans. Fine foreign materials tend to segregate during loading and occupy void spaces in the central region of the grain mass. The larger and lighter materials will accumulate close to the walls of the silo. Consequently pockets in the grain mass are potential sites for hot spots, creating an ideal environment for insects to grow and multiply. Cleaning soya beans prior to storage will reduce the risk of spoilage and economic loss.

Table 1: Recommended safe storage periods for soya beans with different moisture (ACA-SIO, 1997).

Moisture content percentage	Safe storage period
10 – 11	4 years
10 – 12,5	1 to 3 years
12,5 – 14	6 to 9 months
14 – 15	6 months

Temperature

Temperature affects the development of fungi and can create chemical changes, such as hydrolytic and oxidative rancidity. Temperature also affects the development of insects and pests, which multiply at an optimum temperature of between 27 and 35ºC. A combination of high moisture and high temperature promotes the development of fungi. Most common fungi have faster growth rates in conditions above 16ºC.

Fungi can be expected to start growing after a few weeks at a moisture of above 14% and a temperature of above 30ºC, as compared to a few years if kept at 5ºC. The combination of moisture and temperature must be considered when deciding on the moisture at which the soya beans will be stored.

Temperature also causes moisture migration. The driving force in moisture migration in grain mass is temperature gradient. This condition causes very small air movements and water vapour translocation in the grain mass. Grains stored at moisture levels considered safe, may spoil because of moisture migration associated with inter-seed currents.

Moisture

To reduce the chances of shattering losses, harvest should begin at seed moisture levels of between 12 and 14%. Harvest at moisture levels of below 10% result in brittle beans that are more likely to split during storage and handling. For maximum weight and minimum field losses, the optimum harvest moisture advocated is between 13 and 15%. If storage bins have the capacity for drying with air blowers, harvesting at 16% is possible. Producers waiting for the ideal moisture of 12% often experience difficulty harvesting an entire crop without losses in yield and quality, either from shattering, lodging or disease. Pre-harvest losses will be minimised if the crop is harvested before the bean seed moisture reaches 10%.

If soya beans are harvested at high moisture levels, they must be dried to 13% as quickly as possible. Advantages of a high-moisture harvest are earlier harvest, less shatter loss and more available harvest time. Disadvantages are more threshing loss, more damaged seed and the expense of drying to an acceptable moisture level. A moisture level of 11% is desirable if beans are kept for longer than six months.

Deterioration indicators

Heat is the most common indicator of a problem in stored grain and oilseeds. High grain temperatures normally indicate either microbial or insect activity, and if left unchecked they may lead to heat-damaged or charred grains. As soya beans exceed 50ºC, the oxidation of oil therein becomes a self-sustaining process. A temperature-monitoring system in soya bean storage silos is essential.

Colour of grains

The appearance of grains is considered a critical and decisive factor in the commercialisation process. Discolouration is indicative of physical or chemical alterations, presence of metabolites and other unfavourable characteristics. The darkening of soya beans during storage is an important qualitative indicator of deterioration. Darkening is significantly increased over time if the grain is stored at a high temperature and humidity.

Oil quality

Soya beans that have been damaged in storage can affect free fatty acid content, which in turn can affect taste and odour, including an increase in refining losses of up to 4%. Free fatty acid content increases significantly in soya beans stored between 13 and 20% moisture, and this increase is exacerbated by high temperatures.

Drying

Soya beans can be rapidly dried after harvest to reach an acceptable moisture level. There are several types of high or low temperature dryers. The purpose of drying is to lower moisture to guarantee favourable conditions for storage and further processing or handling of the product. Drying of beans can be done by circulating air at varying degrees of heat through a mass of beans. The flowing air imparts heat while absorbing the humidity of the outer layers. Reduction in moisture content unfortunately does not take place uniformly.

Avoid dryers that re circulate or stir grain constantly. Dryers should minimise drop heights. Beans that have been cleaned will dry more readily and be of better quality. Cooling is one of the greatest benefits gained from moving and turning soya beans in an elevator. Relative humidity of the drying air determines the moisture to which the grain will dry.

Natural drying by exposing beans to the sun is recommended, where atmospheric conditions favour the reduction in moisture over a reasonably short time span.

Conclusion

There is no fixed recommendation for moisture levels at which soya beans can be stored, but only guidelines that vary depending on conditions. The lower the foreign material, the lower the temperature and the higher the moisture level will be at which soya beans can be stored. Storage time and the type of silo used will also make a difference to the moisture content at which to store soya beans.

If storage periods are likely to be long and take place partially in South African summer months, the current maximum 12% moisture is a very logical and sensible parameter. Storing at higher levels of moisture will pose a significant risk. If there is certainty that soya beans will be stored for a very short period of time, not exposed to high temperatures and used rapidly, the possibility of increasing to 13% moisture is strong. The risk of soya bean spoilage will increase when storing at higher moisture levels.

Drying of soya beans is an option where the facilities are available, but the damage during the drying process should be controlled. The cost of drying also needs to be considered.

Extracts used from literature. References available from the author at email erhardb@netactive.co.za